PETROLOGICAL NOTES.

No. ii. The Relations between some Western Australian Gneissic and Granitic Rocks.

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The following notes are the results of three visits to Roelands and one to Albany. As I may not be able to resume the work, it is given here as it stands. Detailed mapping was begun at Roelands, but was not carried far enough to be of value. Practically no laboratory-work was done, therefore all rock-names must be interpreted as field-names only.

The Geology of the Roelands District.

Roelands, 113½ miles from Fremantle, on the South-West Railway, stands at the foot of the Darling Range (fault-scarp), east of Bunbury. The surrounding country was examined by a number of traverses between the Collie and Brunswick Rivers, as far east as Shenton Elbow on the former, and Olive Hill Siding on the latter. The formations met with are, in order of increasing age—

Alluvials.
Laterite.
Conglomerate.
Basic dykes.
Pegmatites.
Gneiss.
Porphyritic granodiorite.

The Alluvials occur all along the foot of the range, and in the Brunswick River Valley, where they are stratified.

Laterite is sparingly distributed as a capping on the highest hills, about two miles east of the foot of the range.

An outcrop of *Conglomerate*, to be correlated tentatively with the Donnybrook Series, occurs as a low hill between the railway and the foot of the range, but separated from the range by alluvials, about a mile north of Roelands. The matrix is a fine-grained, reddish-brown grit, and contains well rounded pebbles and boulders of pegmatite, aplite, light quartzite, dark sandstone, and decomposed, basic, igneous rocks, from ½″ to 2′ in diameter.

The granodiorite, gneiss, basic dykes, and pegmatites form all the high land east of the railway, except where capped by laterite. They are intimately associated in the field.

The basic dykes intrude the acid rocks, forming a plexus, with only occasional approaches to parallelism. They show no distinct trend, and vary in width from mere veins to 50 feet and more. They are coarsely holocrystalline, variable in grainsize and basicity, and appear in most cases to be amphibolitic. They are often gneissic, sometimes passing from a granitoid texture in the middle, through a gneissic or schistose phase, to biotite-schist on the edges. They are generally associated with gneiss, rather than granodiorite.

The Granodiorite-Porphyry forms a number of sporadic outcrops, some of which are of large dimensions, and are fairly free from basic dykes. It is well developed just north of the Collie River, half-way between Shenton Elbow and the railway, also around Olive Hill Siding, and between Brunswick Junction and the Roelands quarry. It is a coarse, granitic rock, with very numerous felspar-phenocrysts, up to 2″ long, distributed entirely without arrangement in the most characteristic outcrops, where it weathers into small, rough tors. In the neighbourhood of the gneiss, it is rudely fluidal.

The Gneiss is most varied in character, and outcrops as irregularly as the granodiorite, but shows no definite boundary-relations to it. It is very well exposed along the Collie Tramway. There is not the slightest evidence that the granodiorite intruded it. All varieties, from fine, even-grained gneiss to coarse augen-gneiss occur, some of the latter bearing a suspicious resemblance to the fluidal modification of the granodiorite. The foliation follows no constant direction; on the other hand, it is best developed in the neighbourhood of basic dykes, and runs parallel to them. The more intense the foliation in the basic dykes, the more perfect are the neighbouring gneisses. In places, it is much contorted; it is then often associated with pegmatites, and may be intruded *lit par-lit* by amphibolite. The contortion is well shown in some cliffs on the north side of the Brunswick River Valley, near post 1997 on the Narrogin railway. A zone of contortion seems to run S.W. through this point, as it is met in several places south of the river too.

The Pegmatites are widely distributed, but are not abundant. In the hills south-east of Olive Hill Siding, they are associated with masses of a green, actinolitic mineral, and an earlier, talcose mineral, both as yet undetermined, the latter probably being a pseudomorph. These minerals also occur in the pegmatite-outcrops on the south side of the small valley beyond Flaherty Brook, S.E. of Roelands quarry.

The relations between the granodiorite, gneiss, and basic dykes, were most clearly shown in the Roelands quarry. Numerous dykes were exposed, some of which were foliated. In many places, in the main quarry, the granodiorite was seen to pass, in the direction of a basic dyke, by imperceptible gradations, into a fine-grained gneiss bordering the dyke, its foliations running parallel to the dyke, which was also slightly foliated, the edges being biotite-schist. Undoubtedly the gneiss is derived locally from the granodiorite, and its formation is connected with the basic dykes. At the south end of the quarry, a section was exposed showing three parallel dykes; between the first and second from the east, the granodiorite was unaltered, but between the second and third was a highly contorted gneiss, with a few felspar-phenocrysts.

The change from porphyritic granodiorite to fine-grained gneiss is very definitely shown by the felspar-phenocrysts, in the following arbitrary stages in the transition :—

1. Unaltered, porphyritic granodiorite; phenocrysts not oriented.
2. Phenocrysts fluidally oriented.
3. Phenocrysts fluidally oriented, and crushed peripherally.
4. Phenocrysts fluidally oriented, elongated and distorted.
5. Phenocrysts dragged out, and crushed into long streaks of granular felspar.

6. Fine-grained gneiss, without phenocrysts.

Perfect series of specimens can be collected in the quarry.

The above facts lead me to advance the following hypothesis. The gneisses of the Roelands District were produced from the porphyritic granodiorite by uneven shearing processes, which accompanied the injection of basic dykes, under intense pressure. Earth-movement was prolonged after the intrusion of the dykes.

The pegmatites appear to belong not to the granodiorite, but to some neighbouring intrusive, perhaps the Collie granite, an entirely different rock.

Physiography.—The Darling Fault-Scarp has a more dissected and mature aspect in the Roelands District than near Perth. This is also expressed by the scarcity of laterite, and its retirement from the edge of the range. This greater maturity is probably due to the heavier rainfall of the South-West.

There is a marked contrast between the valley of the Collie River west of Shenton Elbow, and that of the Brunswick. The latter is more mature, meandering, and well filled with alluvial; whereas, though the two are only three to five miles apart, the former, though the larger, is a straight, V-shaped trench, with more tributary gullies on the south than on the north. This suggests that the Collie follows a fault from Shenton Elbow to the west, where it takes a sudden turn from its former course.

The material from the Roelands quarry is being used for the breakwater at Bunbury, the quarry having been recently reopened. The quarry-face has now a very different appearance from what it had when I saw it last.

The Crystalline Rocks of Albany.

Previous observers have recorded only granites and basic dykes from the old crystalline complex of Albany. A number of different rocks occur there, however, and their relations are clearly shown in many fine exposures. The following types have been distinguished, and are arranged in order of increasing age—

Basic dykes (two series).
Pegmatites (two series).
Aplite.

Microgranite.
Porphyritic granodiorite.
Gneiss.

They comprise, in all, a fundamental gneiss, and igneous rocks belonging to at least two, perhaps to three periods of activity.

The gneiss and granodiorite are very much alike in appearance, especially when weathered, which is probably the cause of their not having been separated before. Their boundary, likewise, appears to be a very complicated and irregular one.

The Gneiss is variable, but generally coarse, and porphyritic with felspar. It forms part of the mass of Mt. Clarence, and Mt. Adelaide. At the south end of Middleton Beach, the folia strike at 272° prismatic, a trend which is maintained elsewhere. Between Mts. Clarence and Adelaide is a contorted zone, where it becomes garnetiferous, finer in grain, more irregular in composition, and contains dark schlieren. This zone is well exposed at the timber-yard between the deepwater- and town-jetties. Further south, near the entrance-beacon, a junction with granodiorite is exposed.

The Porphyritic Granodiorite forms the bulk of Mt. Melville, and part of Mt. Clarence, and occurs also as dykes in the gneiss. It is remarkably like the Roelands rock, but its large felspar-phenocrysts are generally fluidally arranged along different directions. It weathers into large, characteristic tors, which are a feature in the scenery of the district. Two very fresh dykes, exactly like the main rock, cut the gneiss on the coast, about one-quarter of a mile south of the south end of Middleton Beach. They are each a foot wide, and ultimately run together. They are cut and faulted by a small vein of microgranite.

The Microgranite occurs as dykes and veins in the granodiorite and gneiss. It is well exposed on the bare flanks of Mt. Melville, and one large dyke runs from the summit of Mt. Clarence down through the reservoir. It sometimes contains large felspar-xenocrysts. At a quarry on a bend of the Middleton Road, it is closely associated with a coarse, epidotic biotite-pegmatite, and is elsewhere bordered by pegmatite.

The Pegmatites occur in two series of veins and dykes, one set closely associated with microgranite, the other cutting it. The older can be seen occurring as irregular blebs, in a microgranite-dyke near the deepwater-jetty, where it also forms a border to the dyke at intervals. The younger occurs intersecting micro-granite in the railway-cutting south of the town-jetty. Both sets are exposed on the shore, north of the deepwater-jetty, where a N.W.-S.E. series cuts and faults a N.E.-S.W. set.

Aplite occurs only rarely, and its age is doubtful. It is older than the pegmatites, as the old one cuts it at the deepwater-jetty, but its relation to the microgranite has not been observed. It has intruded the gneiss, both transgressively and concordantly, on the coast, where the contorted zone appears, between Mts. Clarence and Adelaide.

Darwin recorded two series of *basic dykes* on the south side of the harbour. They cannot be distinguished on the north, as only a few dykes and veins occur. One dyke, near the deep-water-jetty, can be traced some distance seawards; it cuts gneiss, microgranite, and pegmatite, and is crammed with corroded xenoliths of acid rocks and xenocrysts of felspar. The smaller fragments are often associated with patches of sulphides. Some basic veins are to be seen in the railway-cutting, and on the shore, near the baths. They are marginally chilled, and cut microgranite and pegmatite. A slide of the junction of one of these veins with the gneiss, shows the cataclastic structure of the gneiss very well, while the basic rock is exactly like the so-called andesites of the goldfields.

The microgranite, aplite, and pegmatites seem to be related, but there is nothing to show whether they are directly connected with the granodiorite or not.

There are numerous examples of miniature faulting in the district.

For Roelands District, see No.116A of 40 chain Maps, Lands Survey Department, West Australia.